(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 825 465 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
25.02.1998 Bulletin 1998/09

(51) Int Cl.[6]: G02B 6/44

(21) Application number: 97401705.5

(22) Date of filing: 15.07.1997

(84) Designated Contracting States:
AT BE CH DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE

(30) Priority: 21.08.1996 NO 963472

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(54) Optical fiber element for single core power cable

(57) This invention relates to a fiber optic element which is suitable for installation within a single core power cable, in parallel with the cable axis - or in other cables, in conduits or ducts - and comprising one or more optical fibers arranged within a metal tube. The metal tube (5) has an oval or flattened crossection, and the oval tube is oscillated in the plane of its flat side, in order to give the optical fiber(s) the required overlength needed to keep the optical fiber free from mechanical stresses when the cable bends.

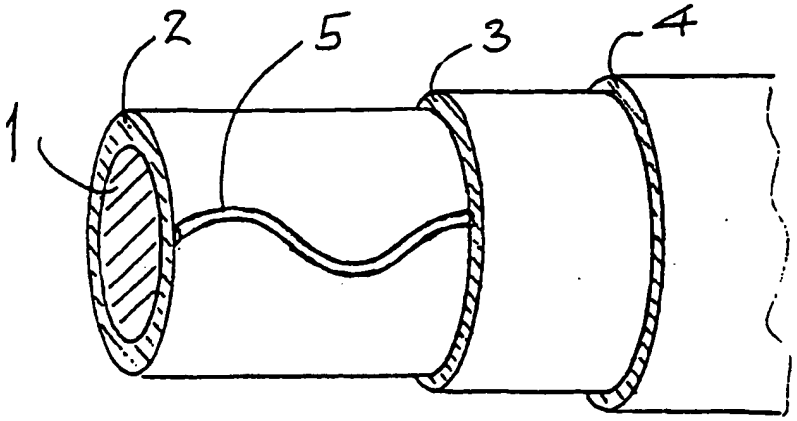


Fig. 1

EP 0 825 465 A1

Description

The present invention relates to a fiber optic element which is suitable for installation within a single core power cable to constitute a composite cable. A single core power cable has a central power conductor and one or more layers of insulation material, as well as an outer metal screen and corrosion protection.

The problem is to make an optical fiber element that would be suitable for installation in the tough environment within a single core high voltage power cable.

The fiber element is to be inserted into the power cable in a stable position between the metal screen and the corrosion protection during manufacture of the power cable by applying the fiber element under or within a buffer sheath in parallel with the cable axis.

It is known from prior art to install ordinary fiber tubes in the outer layers of the power cable. It is, however, difficult - if not impossible - to obtain the necessary fiber overlength, - even if the tube is oscillated. Manufacturing processes are difficult.

The object of the invention is to provide improvements of such composite cables. The main features of the invention are defined in the claims.

The basic idea is to use an oval or flattened oscillated tube for the fiber(s). The solution is to install one or more overlength fibers within a flat or an oval tube and to oscillate the oval tube in the outer layers of the power cable. We have thereby obtained a fiber overlength which is larger than with conventional technique.

The present invention requires special tube forming means, but has proven to be workable by experiment and pilot cable.

With this invention there is provided a fiber element which can be wound on reels or stored in long lengths, - in excess of 10 kilometers, - and which can be inserted into the power cable without interfering with cable armouring or sheathing processes.

Above mentioned and other features and objects of the present invention will clearly appear from the following detailed description of embodiments of the invention taken in conjunction with the drawings, where

Figure 1 schematically shows a power cable for which the invention is applicable, and
Figure 2 shows a fiber optic element.

Figure 1 schematically illustrates the principles of the invention in connection with a single core power cable having a cable core 1, a metal screen 2 which can be a lead sheath, a first corrosion protecting layer 3 such as wound layers or an extruded plastic sheath, and additional corrosion protecting layer(s) 4. A fiber optic element 5 is arranged at the interface between layers 2 and 3 as described below in connection with one embodiment of the invention.

The element 5 is an oval or flattened metal tube (Fig 2) within which at least one optical fiber 6 is oscillated. The flattened metal tube itself is oscillated like a sinus in its flat plane, as indicated in Figure 1. Depending upon the space available within the metal tube 5, it may contain one or more fiber ribbon(s).

The oscillated flattened tube 5 is arranged in parallel with the cable axis on top of the metal screen 2 or on a taping (not shown) over the metal screen. A thin tape, string or the like (not shown) may be spun around the cable core and fiber element 5 in order to keep the element in place before entering an extruder for the plastic sheath 3, or a winding machine for alternative plastic tapes.

The element 5 has no sharp edges pointing into the plastic sheath 3 and there is no risk of tearing the plastic sheath during handling of the cable. There is no need to provide a special slot in the plastic sheath for accommodating the fiber element. The plastic sheath should fully cover the element.

The magnitude of the overlength required is decided from two factors:

a) the diameter of the cable, - or rather the radius at which the fiber element is arranged within the power cable, and
b) the smallest bending radius which is allowed for the power cable. This radius also determines the diameter of reels, drums and the like, on which the cable can be wound or the diameter of pay-off wheels over which the cable must be passed.

The factor b) is most important as the relevant bending radius of the cable can be 2.5 - 5 meters, whereas the cable diameter which is in the order of 100 to 200 mm will be negligible compared to said bending radius.

The required overlength of the fiber is obtained by oscillating the flat metal tube as indicated and by oscillating the fiber(s) within the compartment. The frequency and amplitude of the oscillations are decided in each case, but these factors are limited by the minimum bending diameter of the fiber(s).

With such a construction the optical fiber will be free from any mechanical stress as all such stress is taken up by straightening the tube and the fiber(s).

Whereas the defined fiber optic element is designed especially for installation within the outer layers of a power cable, it will also be suitable for installation in other environments, such as within other cables and within conduits and ducts.

The fiber optic element 5 can be made by feeding the optical fiber(s) 6 into a circular (steel) tube element, while passing the tube through a first set of rollers or other tube forming means (not shown), thus giving the element the required oval or flattened crossection. The flattened tube 5 can then be passed through a second set of rollers or other tube forming means (not shown), thus giving the flattened tube the required sinusoidal form in its flat plane.

The above detailed description of embodiments of

this invention must be taken as examples only and should not be considered as limitations on the scope of protection.

Claims

1. Fiber optic element suitable for installation within a power cable, in parallel with the cable axis - or in other environments - and comprising one or more optical fibers arranged within a metal tube, **characterized in that** the metal tube (5) has an oval or flattened crossection.

2. Element according to claim 1, **characterized in that** the oval tube is oscillated in the plane of its flat side.

3. Single core power cable including at least one fiber optic installation, **characterized in that** the fiber installation consists of at least one optical fiber (6) which is oscillated within a flattened or oval metal tube (5) and that the oval tube is oscillated in the longitudinal direction of the cable.

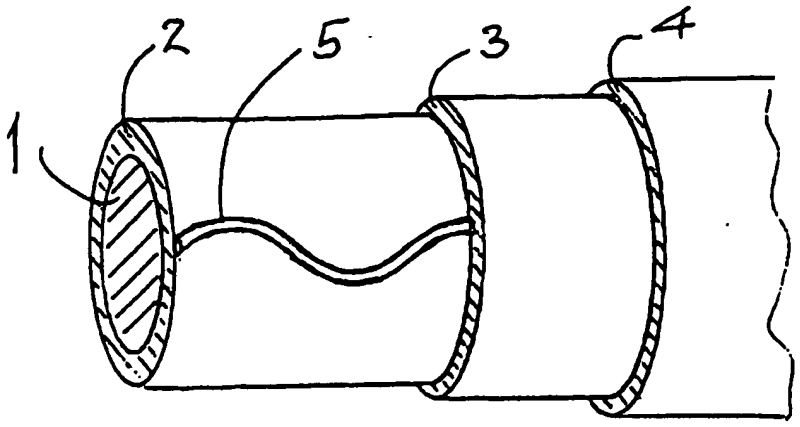


Fig. 1

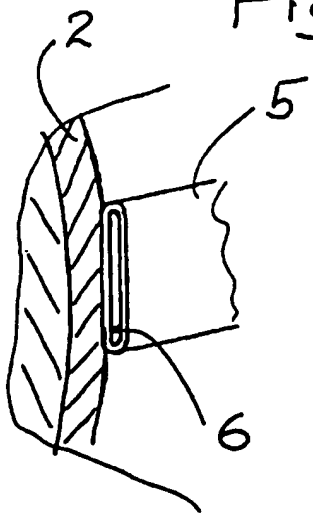


Fig. 2

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 40 1705

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X A	EP 0 155 184 A (BICC PLC) * page 4, line 6 - line 11 * * page 11, line 21 - line 22 * * page 13, line 19 - line 24 * * figures 2,4 *	1,3 2	G02B6/44
X Y A	FR 2 509 480 A (LYONNAISE TRANSMISS OPTIQUES) * page 4, line 2 - line 3; figures 1,3 * * page 4, line 31 - line 33 *	1 2 3	
Y A	US 5 274 726 A (RAWLYK MICHAEL G ET AL) * column 1, line 6 - line 17 * * column 3, line 20 - line 23 * * column 4, line 64 - line 68 * * figures 1,3,8 *	2 1	
A	EP 0 539 915 A (ALCATEL STK AS) * column 2, line 36 - line 49; claim 10; figures 9-11 *	1,3	TECHNICAL FIELDS SEARCHED (Int.Cl.6) G02B H01B
A	EP 0 417 784 A (SUMITOMO ELECTRIC INDUSTRIES) * column 2, line 22 - line 40 * * column 7, line 15 - line 33 * * figures 1,2 *	1,3	
A	PATENT ABSTRACTS OF JAPAN vol. 016, no. 417 (E-1258), 3 September 1992 & JP 04 144010 A (FURUKAWA ELECTRIC CO LTD:THE), 18 May 1992, * abstract *	1,3	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	28 November 1997	Ciarrocca, M

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04L01)

AN - 1994-337190 [42]

TI - Series compensator for electrical power system - includes electrostatic capacitor connected in parallel with the other components, to increase reluctance of system

AB - J06261456 The series compensator has a reactor (3) in series with a semiconductor switch (2). To both the ends are connected a capacitor (1), an overvoltage protection device (4) and a bypass switch (5) in parallel. These components are sealed in a receptacle (6) filled with an insulating medium. The compensator is placed underground.

- ADVANTAGE - Increases stability of system. Raises compensating ratio. Improves safety and reliability. Increases transmission capacity.

- (Dwg.1/12)

IW - SERIES COMPENSATE ELECTRIC POWER SYSTEM ELECTROSTATIC CAPACITOR CONNECT PARALLEL COMPONENT INCREASE RELUCTANCE SYSTEM

PN - JP3315181B2 B2 20020819 DW200261 H02J3/18 006pp

- JP6261456 A 19940916 DW199442 H02J3/18 007pp

IC - H02J3/18 ;H02J3/20

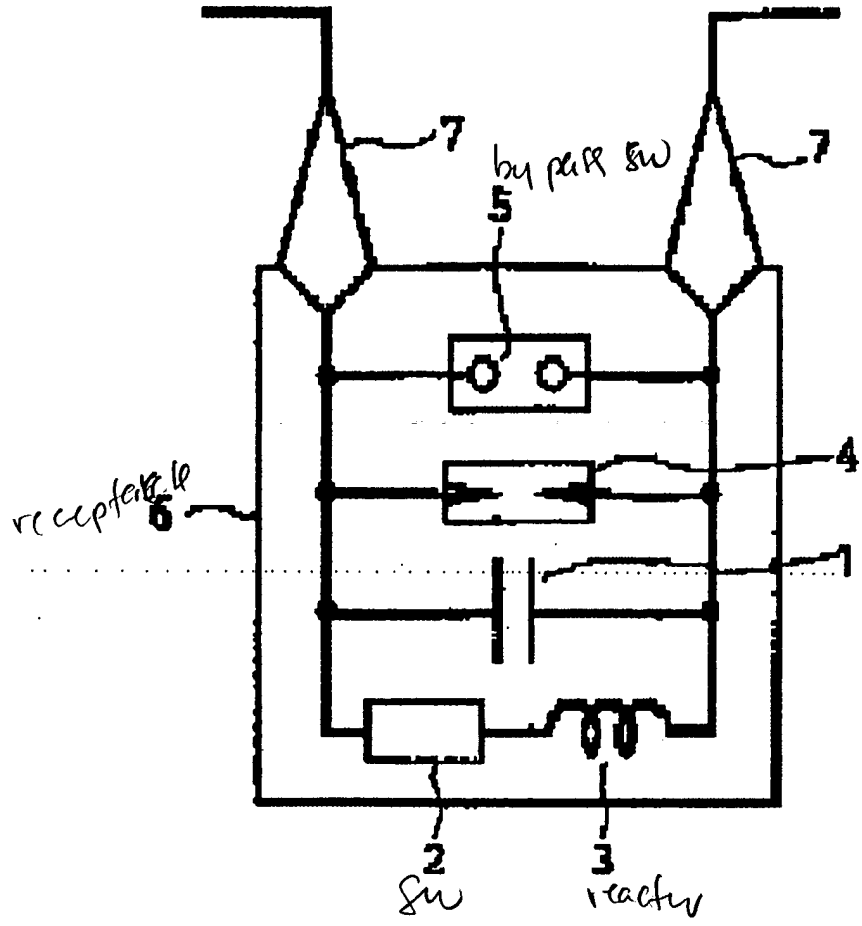
MC - X12-H01A2

DC - X12

PA - (HITA) HITACHI LTD

AP - JP19930043805 19930304; [Previous Publ. JP6261456]

PR - JP19930043805 19930304


7
by pass sw
7
5
4
receptacle
6
1
cap
2
sw
3
reactor